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# Optimal scaling and contingency tables reveal the mismatch between patients' attitude and perception towards their asthma medications and complaints during the I-MUR service provision

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## Abstract

Asthma prevalence is increasing and the economic loss due to lack of asthma control is €72 billion in EU 28. Pharmacists have a role to play, and a bespoke novel pharmacist-led intervention for asthma patients, called Italian Medicines Use Review (I-MUR), has shown both effectiveness and cost-effectiveness. The I-MUR intervention enables asthma patients to optimise the effect of their medications. This study aimed at assessing the mismatch between patients' attitude-perception towards their medications and their complaints during the I-MUR service provision. The I-MUR was provided in four different Italian locations; data were collected and analysed using descriptive statistics, optimal scaling and contingency tables. The number of pharmacists and asthma patients involved in the study was 74 and 895 respectively. The majority of patients (72%) did not believe that they had problems with their medications, 78% confirmed that they had full knowledge and understanding of their medications, 75% said that their medications were working and 45% confirmed that they missed a dose. The number of patients who raised complaints was 683 (76%) and the number of complaints raised by each patient ranged from 1 to 5. Only 18% of the patient population reported having neither medicine-related problems nor asthma-related complaints. The use of optimal scaling and contingency tables unveiled the mismatch between patients' attitude-perception towards their medicines and the type and number of complaints raised by them during the I-MUR service provision.

**Keywords:** optimal scaling, contingency tables, asthma, patients, attitude, perception, complaints, Italian Medicines Use Review, community pharmacy

## 1. Introduction

### What is asthma?

Asthma is a very old word. In modern medical texts, the word "asthma" first originated from the Greek word derived from the verb *Aazein* (breath hard), meaning to exhale with an open mouth or to pant (Asthma History – Through The Ages). Homer mentioned it in some of his books (*Iliad* and *Odyssey*). Originally, asthma did not mean wheeze, but rather noisy breathing, making a blowing nose, panting or even groaning.

Asthma is a chronic pulmonary inflammatory disease that can result in the narrowing of the airways and reversible airflow obstruction when triggered by a variety of stimuli. The narrowing of the airways in the lungs can be caused by one, or a combination, of the following changes (GINA, 2015) [1]:

- swelling of the airways;
- tightening of the muscles surrounding the airways (known as bronchoconstriction);
- production of excess mucus, which can obstruct the airways; and
- long-term damage to the walls of the airways, which prevents them from opening as widely as normal.

### Epidemiology and economic burden of asthma

The prevalence of asthma has been increasing since the late 1990's and it has been estimated that about 400 million people will suffer from asthma by 2025 [2, 3]. Currently, the number of disability-adjusted life years (DALYs) lost to lack of control of asthma worldwide translates into a global loss of 15 million DALYs per year and an estimated one in every 250 deaths worldwide is caused by asthma. Asthma accounts for an economic loss of €72 billion annually in the 28 countries of the EU [4]; this includes the annual costs of health care (about €20 billion), the loss of productivity for patients (€14 billion), and a monetised value of DALYs loss of €38 billion.

### Role of pharmacists in asthma management

Many studies have been published showing the role of pharmacists in asthma management.[5-20] A recent systematic review and meta-analysis of randomised controlled trials of medication review (pharmacist-led consultation) suggested that an isolated medication review has minimal effect on clinical outcomes, no effect on quality of life, and lacks evidence of economic outcomes; although studies have shown a decrease in the number of drug-related problems, more changes in medication, more drugs with dosage decrease and a greater decrease or smaller increase of the number of drugs used. [21]

A recent publication [22] has demonstrated that a novel bespoke pharmacist-led intervention for asthma patients provided effectiveness and cost-effectiveness; this intervention is called Italian Medicines Use review (I-MUR). This novel intervention is a face to face consultation provided by community pharmacists to asthma patients. The I-MUR consisted of a systematic, structured interview with 22 closed answer questions, conducted in a private room within the pharmacy, which covered asthma symptoms, medicines used, attitudes towards medicines and adherence.

Amongst the key success factors of I-MUR, there are some questions tailored to reveal the possible mismatch between patients' attitude and perception about their medicines and their complaints about asthma symptoms, if any.

These types of information were extremely important because they prompted the pharmacists not only to be proactive but also to make the best and most appropriate recommendations during the consultation. This was deemed to be a crucial factor in the success of this pharmacist-led intervention.

## 2. Aim

This paper aimed at assessing the mismatch between patients' attitude and perception towards their medications and their complaints during the I-MUR service provision, using optimal scaling and contingency tables.

## 3. Method

The development of I-MUR was guided by the Medical Research (MRC) Framework for the development of complex interventions, and retrospectively mapped to it. The justification of this approach relies on the fact that I-MUR is a complex intervention.

Full details of the I-MUR development process, data gathering during the study, inclusion, exclusion criteria, patient recruitment, I-MUR provision and data collection have been published elsewhere [23].

### **Data analysis**

Data were analysed using descriptive statistics, contingency tables (cross-tabulation) for categorical data; Goodman and Kruskal's gamma was used for non-parametric data when they had many tied ranks. The questions relative to patients' attitude and perceptions were analysed using an optimal scaling technique called correspondence analysis.

### **Optimal scaling**

Meulman (1998) in her SPSS white paper entitled "Optimal scaling methods for multivariate categorical data analysis" suggested that the aim of the optimal scaling procedure is to turn qualitative variables into quantitative one. This aspect is extremely important in particular for researchers working in social and behavioural science, because they are often required to use data, which are non-numerical, where the recorded measurements are recorded on a scale and therefore have an uncertain unit of measurement. [24] Categories procedures use optimal scaling to analyse data that are difficult or impossible for standard statistical procedures to analyse. These procedures and their implementation were developed for IBM SPSS Statistics by the Data Theory Scaling System Group (DTSS), consisting of members of the Department of Education and Psychology, Faculty of social Behavioural Science at Leiden University in the Netherlands. The approach adopted by optimal scaling is to assign numerical quantification to the categories of each variable, thus allowing standard procedures to be used to obtain a solution on the quantified variable. [25]

The optimal scaling procedure used for our analysis was correspondence analysis because it was recognised as the best statistical approach in our case.

### **Correspondence analysis**

Correspondence analysis (CA) was applied to explore the correlation between two sets of variables (contingency table) producing a visual map which highlighted the correspondence between rows and columns. CA can suggest unexpected dimensions and relationships between categorical data, and the results can be seen analytically and visually.[26]

The CA methodology was initially proposed by Hirschfeld in 1935, [27] it was further developed in France in 1973 by Benzécri et al. [28]; then Greenacre introduced the "Theory and Applications of Correspondence Analysis" in 1984. [29]

The principle of CA is conceptually similar to principal component (PC) analysis, but CA is applied to categorical data, while PC is applied to continuous data. It is possible to use CA for the analysis of cases-by-variables categories matrices for non-negative data. CA is also a multivariate descriptive data analytic technique. As already mentioned, the results and information provided by CA are very similar to the ones provided by PC and factor analysis (FA).[30] The graphical representation provided by CA shows the relationships between column and row categories simplifying complex data and providing detailed descriptions of nearly every single piece of information encapsulated in the data set, yielding a simple but exhaustive analysis.[31-32]

## **4. Results**

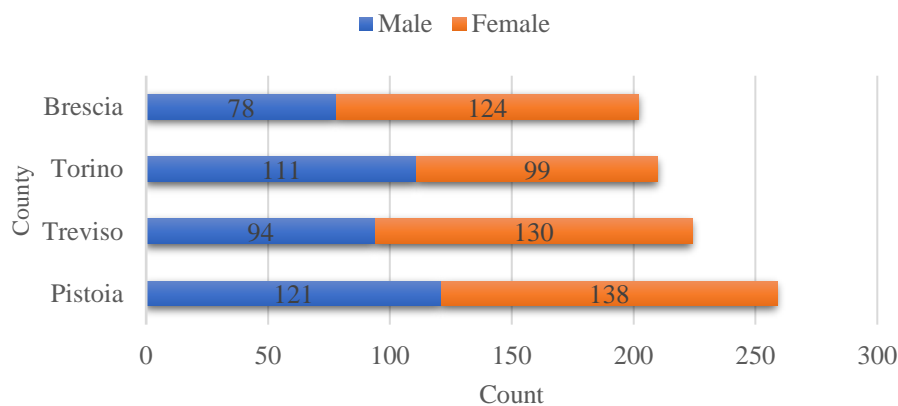
The number of pharmacists who completed the study providing the I-MUR service was 74, the number of patients who received the service was 895. The pharmacists were deliberately divided between the four Italian locations, Brescia, Pistoia, Torino, and Treviso.

### **Patients' demographic data**

Patients were unevenly split by gender, 45.13% (n=404) were male and 54.86% (n=491) female, their ages are shown in Table 1 and the distribution across the four Italian counties in Figure 1.

**Table 1 Age range of patients receiving I-MURs**

Patients' age	N	%
Between 18 and 30 years old	87	9.70
Between 31 and 40 years old	83	9.30
Between 41 and 50 years old	128	14.30
Between 51 and 60 years old	146	16.30
Between 61 and 70 years old	185	20.70
Between 71 and 80 years old	185	20.70
Over 81 years old	78	8.70
Total	892	99.70
Missing data	3	0.30
Total	895	

**Figure 1 Patients' distribution according to gender and county****Patient attitudes towards their medications and adherence to treatment**

The majority of patients confirmed they did not believe they had problems with their medications 72.20% (n=640), while only 25.60% (n=227) indicated they did have some problems and 2.10% (n=19) believed they had lots of problems. Hence there were 27.80% (n=246) patients with self-reported problems. The vast majority of patients 77.80% (n=689) confirmed that they had full knowledge and understanding of their medicines, 21.10% (n=187) only partially and 1.10% (n=10) did not know how to take their medications. In order to visualise the relations between these two sets of responses, correspondence analysis was used.

**Figure 2 Matching problems with knowledge and understanding**

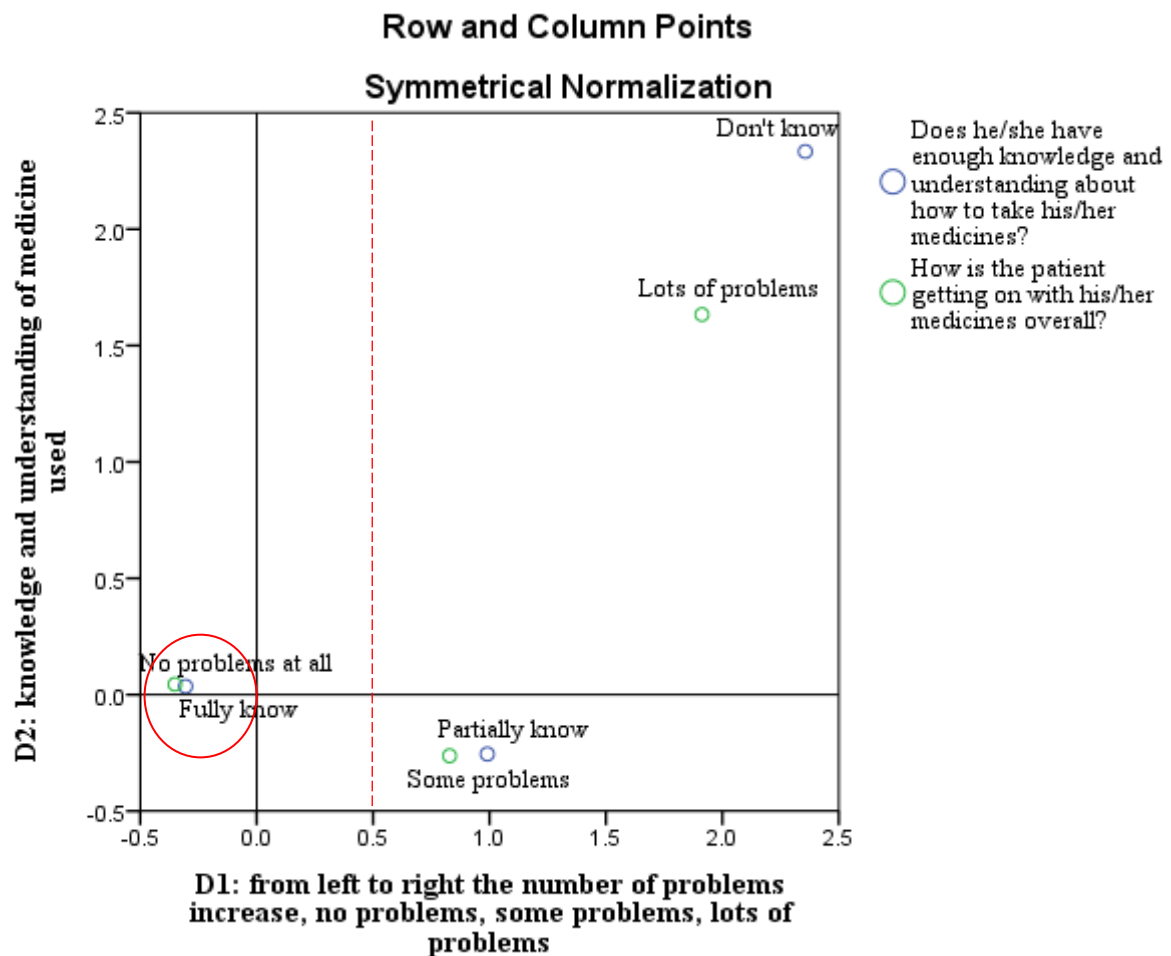


Figure 2 gives a clear representation of the relationship that was found between patients' knowledge and how they get on with their medication: Dimension 2 (D2) is related to patients' knowledge and understanding of their medications and dimension 1 (D1) is showing whether or not patients report having problems with their medications. It appears clear that patients who have a full understanding of their medication do not have problems; patients who have only partial knowledge of their medications have some problems, meanwhile the ones who do not know much about their medication have lots of problems. The dotted red line represents a division of the figure into two parts: left-hand side and right-hand side. The left-hand side of D1 represents patients who did not have problems, they confirmed that they knew and understood their medication fully (>70%) meanwhile the right-hand side represents the percentage (<30%) of patients who were having some/lots of problems and confirmed either knowing their medicines only partially or not knowing at all. A positive linear correlation was found between these variables ( $\gamma = 0.649$ ,  $p < 0.01$ ).

A similar analysis between believing medicines are working and expected efficacy was conducted. The proportion of patients (n=882) who thought that all their medicines were working was 74.70% (n=659), 20.40% (n=180) confirmed that some are working, 0.70% (n=6) none are working and 4.20% (n=37) did not know. The proportion (n=882) who thought their medicines were as effective as he/she was expecting were 75.60% (n=667), the ones who did not 14.70% (n=130) and 9.60% (n=85) did not know.

**Figure 3 Patterns between patients' expectation and are medicines working**

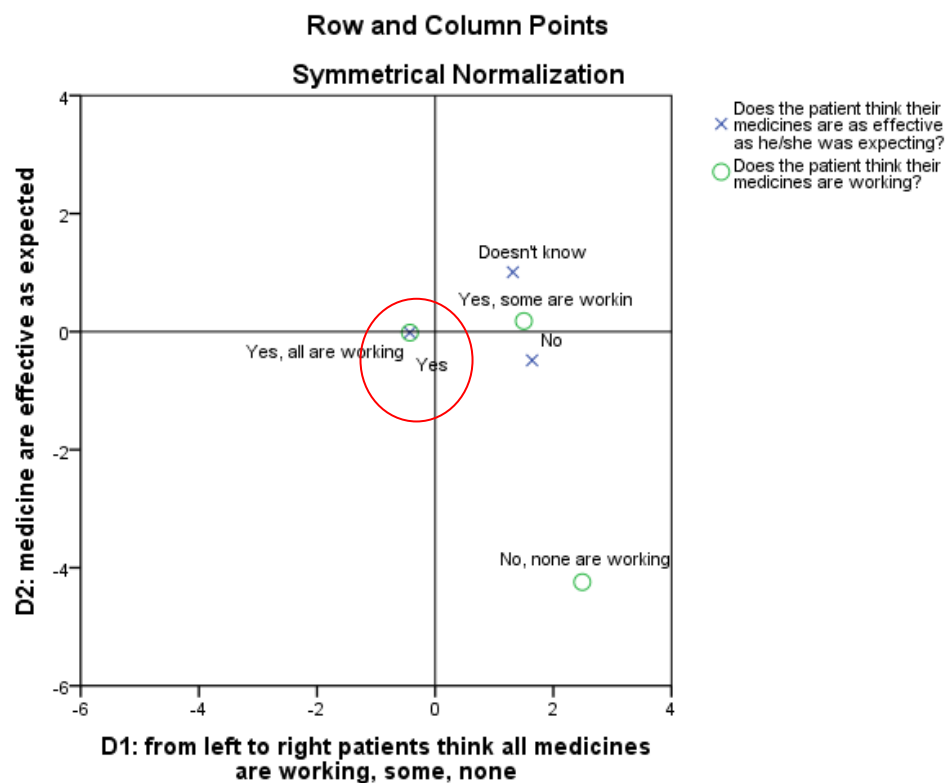


Figure 3 represents patients' perceptions about their medications. D1 explains, from left to right, the way in which patients perceive how their medicines were working, and this value decrease moving from the left side to the right side of the X-axis. D2 shows if patients believe that their medications were effective as they were expecting. D2 is not clearly interpreted as D1. The statement "No, none are working" stands alone and only five patients chose this option. Patients who have chosen "yes some are working" is placed between the other two statements "doesn't know and "No". In this figure, the red circle shows patients who confirm that all the medicines they used were working according to their expectation. A strong positive linear correlation was found between the two questions ( $\gamma = 0.88$ ,  $p < 0.01$ ).

#### **Patients' self-reported adherence to asthma medications**

Adherence to treatment was assessed using two questions. Of the 895 cases, the question: "Does the patient miss any doses of his/her medicines or change when he/she takes them?" was completed in 882 cases. Of these, 44.58% (n=399) patients confirmed that they miss a dose or change when they take their medications, 51.40% (n=453) did not and 3.40% (n=30) did not know. In the entire sample population, 50.50% (n=202) of male patients were potentially non-adherent to treatments compared to 40.90% (n=197) of females. The last time the patient missed a dose was reported for 623 cases. This showed that 54.50% (339) patients did not remember when was the last time they missed a dose, 12.40% (n=77) last week, 11.90% (n= 74) this week and last month, 9.30% (n=58) yesterday.

### Problems and complaints

After the initial question about problems with medicines, the I-MUR template included a list of specific complaints relating to asthma, about which patients were asked. The responses are summarized in Table 2.

**Table 2 Self-reported complaints identified by patients during I-MUR interviews**

Complaints	N	% of incidence of each complaint
Daytime symptoms such as shortness of breath, tightness in the chest, coughing, wheezing, or exacerbations	470	35.91
Limitation on activity, including exercise	357	27.27
Need for rescue medication	237	18.11
Night time awakening	180	13.75
Other	65	4.97
Total number of complaints	1309	

The number of patients who indicated they had one or more complaints was 683 (76.3%). The total number of different complaints identified by patients was 1309 (Table 2) with a mean of 1.9 per patient; patients could select multiple options, therefore, the percentages do not sum to 100%. Complaints related to daytime symptoms were most frequently identified by 470 (35.91%); 9.5% (65) were classified as others such as hands shaking, muscle pain, heat, dizziness, tachycardia, fatigue. Positive correlations were found between age and number of complaints ( $\rho = 0.12$ ,  $p < 0.001$ ), number of active ingredients and number of complaints ( $\rho = 0.25$ ,  $p < 0.01$ )

**Table 3 Number of complaints made by patients**

No of complaints	No of patients	%
1	289	42.31
2	218	31.92
3	122	17.86
4	50	7.32
5	4	0.59
Total	683	



A cross-tabulation of the two questions was conducted to find out if patients who did not indicate any problems with medicines subsequently confirmed not having asthma-related complaints when specific questioning was used (Table 4).

**Table 4 Cross-tabulation of multiple response sets: Complaints versus problems**

Does the patient complain.....	Problems		Total
	(no problems)	(some/lots)	
Daytime symptoms such as shortness of breath, tightness in the chest, coughing, wheezing, or exacerbations	291	175	466
Night time awakening	105	74	179
Need for rescue medication	141	96	237
Limitation on activity, including exercise	217	137	354
No complaints	144	10	154
Total	575	232	807

Comparison of responses to these two questions indicated that 10 patients out of the 807 (90.2%=802/895) who replied to both questions had no complaints but did have medicine-related problems. However, of the 575 who indicated that they did not have medicine-related problems, only 144 (25.04%) also had no asthma-related complaints. Overall only 144 (17.84% =144/807) patients reported having neither medicine-related problems nor asthma-related complaints.

## 5. Conclusions

The use of correspondence analysis enabled the visualisation of patients' attitude towards their medication indicating that the vast majority of patients were happy with their medications. Nevertheless, different results were highlighted by tables showing patients' complaints. The results are showing a clear mismatch between patients' attitude and perception and the reality. In fact, data gathered during the I-MUR service showed that of 575 patients who initially indicated they did not have any medicine-related problems, the majority, in fact, had at least one asthma-related complaint.

The combination of CA and cross-tabulation allowed acquiring a clear picture regarding the mismatch between patients' attitude-perception and the type and number of complaints raised by the patients.

This project is the first project ever conducted in Italian community pharmacy testing whether pharmacists were able to undertake the process of completing an I-MUR with asthma patients and uploading the data onto the platform. The results have shown one of the first application of CA to analyse the results obtained during a pharmacist-led intervention. These results need to be confirmed by a larger study.

This analysis provided a clear insight into patients' attitude-perception and the mismatch between these two domains and the type and numbers of complaints raised by the patients as well. This mismatch prompted the pharmacist to act pro-actively making suggestions and recommendations to asthma patients. [22]

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### **Conflict(s) of Interest**

None.

### **Ethical Standard**

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The study was approved by the University of Kent Ethics Advisory Group for Human Participants on September 19<sup>th</sup>, 2012 (ref. No 020S11/12).

### **Informed consent**

Informed consent was obtained from all individual participants included in the study. Participants consented to the study after full explanation of what was involved was given. Signed consent forms from pharmacists were retained in the University. Signed consent forms from patients were retained by pharmacists in the pharmacies.

### **Anonymity and data storage**

Data obtained during I-MUR consultations were coded and stored electronically on a computer system at the University of Kent, in a directory which is password protected. Hard copies of any patient data, if any were collected during the I-MUR, were the responsibility of the participating Italian pharmacists to store in a secure filing cabinet in their pharmacies. All electronic data regarding this study have been password protected and are accessible only by the researcher.

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